Viral Hemorrhagic Septicemia (VHS) Briefing Paper

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- *What is VHS?* VHS is viral hemorrhagic septicemia, a viral fish disease that has caused large scale mortalities in rainbow trout and turbot aquaculture operations in Europe and in Pacific herring and pilchard populations along the Pacific Coast of North America. The disease is caused by a rhabdovirus, Viral Hemorrhagic Septicemia Virus (VHSv). This virus has a number of identified isolates (unique genetic types) grouped in four types; three from Europe and one from North America. Each appears to have unique effects with specific pathogenicity on certain species. The isolate found in the Great Lakes Basin here is most similar to the VHS strain previously isolated from the Atlantic Coast in Eastern North America.

- *Is VHS a reportable or emergency disease?* VHS is a reportable disease that requires notification of Departments of Agriculture, United States Department of Agriculture – Animal and Plant Health Inspection Service (USDA- APHIS), appropriate Canadian Agencies and OIE (International Organization for Animal Health). It is also listed as an emergency disease by the Great Lakes Fishery Commission - Great Lakes Model Fish Health Program. If this disease gets into a fish production facility or hatchery, the facility must be de-populated and all fish destroyed under the current Great Lakes Model Fish Health Program.

- *What does it do to fish?* VHSv types I-III is known to cause mortalities in short periods of time, particularly in rainbow trout. The virus is more active in colder water (< 10 C) which is why mortalities are often seen in the spring. Fish exhibit hemorrhaging in the skin including large red patches, particularly in on sides and anterior portion of the head. However, infected fish will sometimes exhibit very minor external hemorrhaging (pin-point spots called petichia) or no external signs at all. Internally, all organs are often congested with multiple hemorrhages in the liver, spleen, and intestines. The swim bladders are also often extremely congested with hemorrhages, giving the otherwise transparent membrane a mottled appearance. Sick fish will often appear listless, swim in circles, or hang just below the surface based on staff observations made this past spring.

- *Has VHS caused mortalities in the Great Lakes?* In the eastern part of the Great Lakes Basin, a large scale mortality of freshwater drum occurred in 2005 in the Bay of Quinte, Lake Ontario in Ontario. In the spring of 2006, large scale fish mortalities were observed in Lake St. Clair (Great Lakes muskellunge and yellow perch), St. Clair River (gizzard shad), Detroit River (Great Lakes muskellunge and gizzard shad), Lake Erie (west basin -freshwater drum and white bass, and central basin-yellow perch), Lake Ontario (round goby) and St. Lawrence River (Great Lakes muskellunge). VHSv isolated from the affected fish proved to be of Type 4 (North American isolate).

- *How is VHS transmitted?* VHSv can be transmitted by urine, feces and sexual fluids. Reservoirs include clinically ill and carrier fish that do not show signs of the infection. The virus can be found on the surface of the salmonid eggs during spawning of infected female broodstock (sometimes at very high levels) and is capable of persisting for a sufficient time period to result in vertical (actually egg-associated) transmission between generations (adult to progeny). It is also likely to enter the body through the gills or through wounds, although oral transmission is unlikely. Experiments showed that blood sucking parasitic arthropods and leeches can transmit the infection physically.

- *Can fish eggs be treated to reduce VHS transmission?* In the western United States, salmon eggs are routinely surface disinfected with iodophor (an iodine compound) at or after water hardening to eliminate vertical (parent to egg) transmission. There are no treatments at this time to stop horizontal (fish to fish) transmission. A few viruses, like IPNV, are physically inside the egg and, therefore, difficult to disinfect and result in true vertical transmission. This is not the case for VHSv.

- *Are there any human health effects from VHS?* This virus does not infect humans. There are no concerns with respect to human health with this pathogen and it can not infect humans if they eat fish with the pathogen.

- *Where has VHS been found within the Great Lakes basin?* As of this date, the VHSv has been confirmed from the St. Clair River, Lake St. Clair, Lake Erie (all three basins), Niagara River, Lake Ontario (Bay of Quinte, Ontario and Rochester, NY area) and the St. Lawrence River.

- *Will VHS spread to the other Great Lakes and when?* While the exact timing is impossible to determine, it is highly likely that the virus will be found in lakes Michigan and Huron in the next 2-4 years. This is based on the large scale fish movements, particularly walleye, from the Lake St. Clair-Lake Erie corridor to Saginaw Bay and from there north to the Mackinaw Straits. If fish continue to be the key movement vector, the virus will likely take a long time to get established in Lake Superior as fish movement through the Soo Locks is limited.

  This situation could rapidly change if the key vector is ballast water exchange. Duluth Harbor in Western Lake Superior has the second highest exchange rate in the Great Lakes and the Chicago area also has a very high exchange rate. The virus could quickly be spread by this vector if the virus can remain alive for sufficient time to be transported by this method.

- *Which species are affected by VHSv Type 4 in the Great Lakes?* VHSv has been confirmed in 15 coolwater and 1 coldwater species. It has not been confirmed in any coldwater species (whitefish, trout and salmon) fish to date and the virus' effects on salmonids is not known.

To date VHSv has been implicated as a mortality factor in large fish kills in freshwater drum (lakes Ontario and Erie), Great Lakes muskies (Lake St. Clair), round gobies (Lake Ontario), gizzard shad (St. Clair River), white bass (Lake Erie) and yellow perch (lakes Erie and Lake St. Clair).

VHSv has also been confirmed in smaller mortality events in smallmouth bass (Lake St. Clair), freshwater drum (Lake St. Clair), black crappie (Lake St. Clair), and bluegill (Lake St. Clair).

A number of other species in other collections have been identified as carrying VHSv, but were not symptomatic of the disease included: smallmouth bass (Lake Erie); rock bass (Lake St. Clair); silver redhorse (Lake St. Clair); northern pike (Lake St. Clair); walleye (Lake Erie); shorthead redhorse (Lake St. Clair); burbot (Lake Ontario) silver redhorse (Lake St. Clair); and emerald shiners (Lake Erie and the Niagara River). Mortalities have not been observed for any of these species.

- *When did VHS get here?* The earliest confirmed report is 2003 in a Great Lakes muskellunge from Lake St. Clair so it is likely to have been introduced here in 2002 or 2003. At the time of collection, the virus was initially classified as an unknown rhabdovirus and recently confirmed in 2006 as VHSv Type 4.

- *How did VHS get here?* It is not known exactly how this virus arrived in the Great Lakes nor is it known how long the virus has been here. Ballast water discharge is considered as a likely vector given its distribution in the lakes and the likely origin of the virus, the Maritime Provinces of Canada.

- *What are the likely risks to fish populations?* Little is known about this particular isolate of the VHSv virus. The VHSv-European Types 1-3 isolates have caused large-scale mortalities in salmonid and turbot aquaculture facilities in Europe and mortalities have been documented in the Pacific Coast for herring species. Until the recent mortalities in the Great Lakes, the Type 4 isolate was not known to cause large disease scale outbreaks on the East Coast of North America except for one potential and unconfirmed instance in mummichogs from New Brunswick.

  It is very unclear what the risk is to our fish stocks from this pathogen as susceptibility and virulence studies have not been done on this isolate. It does clearly cause large scale mortalities in susceptible fish populations. It is possible that VHSv infections will initially result in increased natural mortality and fish kills for the stocks involved, similar to largemouth bass virus (LMBv) outbreaks, but will not result in any appreciable long-term changes in population abundance levels. Fish that have recovered from the infection are likely to serve as reservoirs to maintain the virus for future outbreaks which will have fish management implications for the use of fish from infected waters. The worse case is that the pathogen causes annual mortalities that will need to be factored into fisheries management plans. It also appears that there are a wide range of

potential carriers for the pathogen which will need to be factored into fisheries management options.

Another very large unknown is whether this isolate has the ability to cross over to salmonids and cause disease in these species in the wild.

- *What are the possible management implications?* Since this pathogen can clearly cause large scale mortalities of valuable adult fish and it has a wide range of potential carriers, it is critical to make every attempt to contain the pathogen and not allow a rapid spread of the disease to all Great Lakes and inland waters. It should be noted that once a pathogen gets into a wild fish community, it is impossible to effectively eliminate it and control is highly unlikely. All potential human caused movement vectors will be evaluated and steps taken to reduce the potential spread of this pathogen.

- *What additional information is needed on VHS?* Basic information is lacking on the specificity and virulence of this pathogen. It is also unknown how long this virus can survive in the environment outside of a fish host, which has implications on ballast water as a vector and methods to disinfect boats and other equipment. This and other basic pathogen information will take time to develop and will greatly inform management decisions. Until that information is available, precautionary principles will be employed to attempt contain this pathogen to its current distribution. Great Lakes resource agencies are taking every opportunity to collect information on the current distribution of the pathogen.

  Additionally, VHSv is found in West Coast systems and management strategies used in those systems is being examined to determine which fish management and culture strategies can be employed in the Great Lakes region to prevent the spread of this pathogen.

By Gary E. Whelan
Fish Production Manager, MI DNR